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Description

[0001] The invention relates to a method of and an apparatus for drilling a borehole in underground formations with at least one formation that has a significantly different formation pressure than an adjacent formation or where time dependent unstable formations do not allow sufficient time to case off the hole in a subsequent run.

[0002] A collapsed hole adds great expense to the drilling of a wellbore and can lead to the abandonment of the hole. Hole collapse can be caused by a number of drilling conditions including shale swelling, sloughing, and unconsolidated sands that cause a hole to wash out or collapse as soon as it is drilled. In these unstable formations, the bore hole can not be cased off and protected in time, when running a liner in a subsequent run after the hole was drilled.

[0003] Another cause of wellbore/hole collapse is an extreme pressure drop between adjoining formations. Drilling into a low pressure formation with a heavy mud that is designed to drill through an overlying high pressure zone will result in severe mud losses and simultaneous hole collapse. An opposite situation is encountered when a borehole is drilled through a first formation having a low formation pressure into a formation of substantially higher formation pressure,.then there is the danger of fluids from the lower formation entering the borehole and damaging the upper formation. If the pressure difference is large enough, there is a risk of a blowout. If the mud weight is increased to prevent such a blowout, then the mud can damage the low pressure formation.

[0004] US 5 472 057 discloses a system for drilling a wellbore having a casing therein comprising a bit assembly attached to a tubular extending from the drilling on the earth's surface to the bottom of the wellbore.

[0005] There is a need for an apparatus and method of drilling boreholes that avoids these problems. Such an invention should-preferably reduce the operational time in its use. It should preferably be adaptable for use with directional drilling systems. It should reduce the exposure of the formations to the dynamic circulation pressure of the drilling mud and thereby reduce formation damage. A further desirable aspect is ro reduce the likelihood of getting stuck in the borehole. In addition, if the apparatus does get stuck, it should be possible to continue drilling ahead.

[0006] The present invention is an apparatus and method for drilling through formations in which the pressure is significantly different from the pressure in the adjacent formations, and/or unstable formations make it difficult to protect the formation with a liner or casing in the hole.

[0007] In one aspect of the present invention there is provided a drilling liner system for use in continued drilling as claimed in claim 1.

[0008] In another aspect of the present invention there is provided a method of continued drilling of a borehole as claimed in claim 14.

[0009] The drilling liner system consists of an inner string carrying an inner assembly having a pilot bit, and an outer assembly having a core bit. Both assemblies are temporarily connected via retractable splines that ensure that the inner and outer assemblies are properly aligned with each other. When running in the hole, the splines are retracted and, upon reaching the proper alignment, extend automatically. After the liner is set, the process of pulling the inner string from the liner forces the splines to retract once again. One embodiment of the invention is a system in which there is no inner string between the bottom hole assembly and the liner hanger. Besides eliminating the trip time for the inner string, this makes it possible to fish the bottom hole assembly out of the hole with a jointed pipe or a wireline. Another embodiment of the invention has a steerable drilling liner, the steering being accomplished by a tilted joint, or with steering pads. Another embodiment of the invention has a sealed annulus between the open hole and the liner. This isolates the open hole from the dynamic pressure of the circulating mud system. Yet another embodiment of the invention incorporates a reamer on the outer part of the liner to enlarge the hole and thereby reduce the risk of getting stuck. An expandable core bit or pilot bit may be used to provide a similar result. Another embodiment of the invention makes it possible to do some additional drilling even after getting stuck. In another embodiment of the invention, high pressure jetting nozzles are used with the pilot bit to enlarge the hole and reduce the risk of getting stuck. Instead of drilling pipe, the drilling liner can be used with coiled tubing.

[0010] Various embodiments of the present invention will now be described by way of example only and with reference to the accompanying drawings, in which:

Fig. 1	shows an overall diagrammatic view of a drilling system with a drilling liner.
Figs. 2A, 2B	show details of the Drilling Liner Bottom Hole Assembly (DL-BHA).
Fig. 3	is a schematic illustration of a modified DL-BHA without an inner string.
Fig. 4	shows details of the releasing tool used in the DL-BHA of Fig. 3.
Fig. 5	is a schematic illustration of a system having a steerable drilling liner.
Fig. 6	is a schematic illustration of a system having a steerable drilling liner with steering pads on the liner.
Fig. 7	is a schematic illustration of a drilling liner that isolates the formation from dynamic pressure variations.
Fig. 8	is a schematic illustration of a drilling liner having an under-reamer.
Fig. 9	is a schematic illustration of a drilling liner having an expandable core-bit.
Fig. 10	is a schematic illustration of a bottom

hole assembly having a thruster for continued drilling when the liner is stuck.

Fig. 11 illustrates a situation in which the pilot bit of the invention of Fig. 10 rotates without the liner being rotated.

[0011] United States Patent Application Ser. No. 08/729,226 filed on October 9, 1996, now United States Patent No. 5845722, discusses an apparatus and method of drilling boreholes in underground formations in which the formation pressures differ considerably. The drilling liner system consists of an outer and inner assembly. Both assemblies are temporarily connected via retractable splines that ensure that the inner and outer assemblies are properly aligned with each other. When running in the hole, the splines are retracted and, upon reaching the proper alignment, extend automatically. After the liner is set, the process of pulling the inner string from the liner forces the splines to retract one again.

[0012] The inner assembly consists of a pilot bit, a male sub, a downhole motor and a thruster or other device to provide the necessary weight on bit. The inner assembly's spline male sub houses the retractable drive splines, which transmit torque from the motor to the outer assembly's core bit. This means that the pilot bit and the core bit turn together at the same rate. The motor provides torque and rotation while the thruster provides a dynamic length suspension of the inner string with respect to the outer string. This allows the thruster to compensate for differential thermal expansion between the inner and outer assemblies. Additionally, the thruster provides the hydraulic weight on bit (WOB).

[0013] The outer assembly includes a core head, a female sub, a suspension sub (bearing sub) and a landing sub. The outer, lower assembly is connected via a crossover to a standard liner with required length. In addition to delivering the cutting action, the core head provides guidance for the inner assembly's pilot bit. The spline female sub forms a locking mechanism for the inner assembly's retractable male splines. The suspension sub offers longitudinal length suspension and delivers radial guidance. Axial forces (WOB) are transmitted to the inner string. Even though no axial bearing is required in the suspension sub, it can be installed, if liner size and drift offered sufficient wall thickness. The suspension sub also ensures that only the core bit and the female sub turn. If required, the rest of the assembly rotates at a lower RPM set at the surface. A liner hanger and running tool connect the inner and outer assemblies in the drilling mode. Following drilling, the liner hanger is set before the running tool is disconnected from the liner and the packer is set before the inner string is pulled out of the hole. The running tool which connects liner and the inner string is usually a part of the liner hanger. If using a single running tool, liner hanger and packer might not necessarily be required and the need for the liner hanger/packer will depend on the application. In the following discussion, embodiments of the invention are shown using a liner hanger, but it is to be understood that it may not be necessary in all cases. During drilling operations, drilling mud emerges from the end of the drill bit and passes into the bore hole so that it can subsequently flow back to the surface through the annular space between the drilling tool and the walls of the bore hole.

[0014] Fig. 1 shows a schematic illustration of an embodiment of the present invention for drilling a borehole using a drilling liner. Shown is a rig 12 at the surface 10 of the earth in which a borehole 8 is drilled. A casing 14 has been set in the upper portion of the borehole. A drilling tubular 16 passes through the casing to a liner hanger/packer 18 at the bottom of the cased portion of the hole and carries a drilling liner - bottom hole assembly (DL-BHA) 22 at its lower end. The DL-BHA has, at its bottom end, a pilot bit 26 and a core bit 24. A liner 20 hangs from the liner hanger 18 at its top end is connected to the DL-BHA at its bottom end. The drilling tubular may be a drill pipe or coiled tubing.

[0015] The liner hanger 18 connects the inner string, the outer line assembly and the drill pipe running string for the drilling mode. After completion of drilling, the liner hanger is set and the running tool disconnects from the liner. Desirable features for the liner hanger are:

(i) Quick and reliable hydraulic setting function that is insensitive to circulating pressure while drilling
(ii) Releasing function that is independent of the setting function.
(iii) All hanger sealing components suitable for handling extreme external pressure differentials resulting from internal pipe evacuation.
(iv) Capability to circulate through the inner string (discussed below) after releasing from the liner.
(v) Capability to run wireline perforators or back off tools below the hanger to allow fishing in case the inner string becomes stuck.
(vi) Capability to allow surface rotation and sufficient torque resistance.

[0016] Details of the DL-BHA are shown in **FIGS 2A** and **2B.** Shown at the top of **FIG. 2A** is a drilling tubular **16** to the surface and the liner hanger **18.** The drilling tubular **16'** below the liner hanger **18** may be of a smaller size than above the liner hanger **18.** A thruster **34** is connected to the drilling tubular **16'** and a drilling collar **16"** connects the thruster **34** to the drilling liner inner assembly **30** while the liner **20** is connected to the drilling liner outer assembly **32.**

[0017] The drilling liner inner assembly **30** includes a drilling motor **40,** the pilot bit **24,** and a male sub **54** with drive splines **52** that transmit the torque from the motor **40** to the outer assembly: Landing splines **44** ensure a proper alignment of the inner assembly to the outer assembly. The outer assembly **32** includes the core bit **24,** a landing sub **46,** a suspension and bearing sub **48** and

a female sub **50** that engages the drive splines **52**. The suspension and bearing sub **48** provides longitudinal length suspension and radial guidance and ensure that only the female sub **50** and the core bit **26** turn and the rest of the outer assembly remains without rotation.

[0018] The downhole motor **40** provides the cutting torque and rotation. The thruster **34** provides a hydraulic weight on bit (WOB) and a dynamic length suspension.

[0019] As discussed in United States Patent Application Ser. No. 08/729,226, a standard drilling BHA is used to drill to the vicinity of a potential problem zone without the liner. The standard BHA is retrieved and the drilling liner is run in hole to continue further drilling through the problem zone. Once the problem zone has been traversed, the liner is set and the inner string is retrieved. Drilling may then continue below the problem zone and if a second problem zone is encountered, the process may be repeated.

[0020] **FIG. 3** shows a schematic illustration of a drilling liner system without the use of an inner string between the liner hanger and the DL-BHA motor. This eliminates the additional weight of the inner string to be carried by the rig. Furthermore it reduces the frictional forces between liner and hole when drilling in highly deviated hole sections. The maximum drilling distance in this kind of wells can be quite large. Shown is a rig **112** at the surface **110** of the earth in which a borehole **108** is drilled. A casing **114** has been set in the upper portion of the borehole. A drilling tubular **116** passes through the casing to a liner hanger **118** at the bottom of the cased portion of the hole. A liner **120** hangs from the liner hanger **118** at its top end is connected to the DL-BHA **122** at its bottom end. The DL-BHA has, at its bottom end, a pilot bit **126** and a core bit **124**. These are as discussed above with reference to **FIG. 1.**

[0021] A landing sub is not necessary because the DL-BHA **122** is temporarily connected to the lower part of the liner **120** by means of a releasing tool **128.** An inner string between the liner hanger **118** and the DL-BHA **122** is not required. The top of the releasing tool is provided with a fishable joint **130** that makes it possible to fish the DL-BHA **122** after the liner hanger/packer **118** is set.

[0022] **FIG. 4** shows details of the DL-BHA with releasing tool **128.** The BHA is connected to the Liner as shown in Figure 3 using the upper liner connection **164.** In contrast to the assembly discussed in **Fig. 2**, instead of the landing sub a cross over sub **175** is used to connect the outer part of the releasing tool to the outer portion of the lower drilling liner. The BHA has on it's bottom end a pilot bit **124,** core bit **126,** female sub **50,** male sub **54,** drive splines **52** and a downhole motor **40** as discussed under **Fig. 1.** Instead of a motor with special bearing housing (featuring the landing splines), a standard available downhole motor can be used. The motor features a screw on stabilizer **176** for centralization of the inner string inside the outer string.

[0023] **Fig. 4A** shows details of the releasing tool. *Instead of the shown Releasing Tool also standard components like e.g. a Baker Oil Tools sealing sub and running tool can be used.* The preferred embodiment of the releasing tool combines the releasing mechanism and the sealing features in one single tool assembly to reduce the total length of the BHA. This makes it possible to pre-assemble the BHA offsite and send to the rig side as a single component.

[0024] The releasing tool as shown under **Fig. 4a** features an outer string, which will stay in hole, and the inner string, which will be tripped out of hole after the liner is set. The inner string and the outer string are temporarily connected by means of the locking splines **162.** Variations in length due to temperature changes, and errors in manufacturing tolerances, are compensated for by the axial stroke of the suspension ub **48.** The outer string includes the top sub **161** with the upper liner connection **164,** the locking sub **173** and the cross over sub **175.** The cross over sub **175** is connected to the lower outer Drilling Liner BHA. The inner string constituting the retrievable parts comprises of the pulling sleeve **171** including a fishable joint **160,** the stop sleeve **174,** the optional seal carrier **168,** locking splines **162,** a first mandrel **169** and a second mandrel **170.** The second mandrel **170** is connected on it's lower end to the downhole motor **40.** Shear screws **166** keeping the pulling sleeve **171** and the first mandrel **169** temporarily connected. Shear screws **171** do not transmit operational drilling loads. The stop sleeve **174** prevents the locking splines **162** from retracting. The inner and outer string are sealed against each other by means of high pressure seals **163** and **176.**

[0025] When fishing the drilling liner inner string, the fishing string (not shown) is tripped in and connected to the pulling sleeve **171.** The make up torque when applied is transmitted from the pulling sleeve **171** via a toothed connection to the first mandrel **169.** When the fishing string is pulled, the shear screws **166** break, and the pulling sleeve **171** will move upwards until the stop sleeve **174** shoulders against the first mandrel **169.** The seal carrier **168** build up a chamber to allow the locking splines **162** to retract. The locking splines **162** have inclined shoulders which generate a radial load on to the locking splines **162** when pulled. Continued pulling on the fishing string causes the locking splines **162** to retract. After the locking splines **162** are fully retracted, the inner string is disconnected from the outer string. The drilling liner can now be pulled out of hole along with the motor and the pilot bit. During the process of disconnection, mud circulates from the upper bypass port **172** into the inner string and out through the opened bypass port **167** of the first Mandrel **169.** This reduces the surge and suction pressures.

[0026] The embodiment of **FIGS 3** and **4** has a number of advantages over the embodiment of **FIGS. 1-2.** The trip time may be reduced in certain applications. When no thruster is used, the bottom hole assembly does not have any additional hydraulic components.

The bottom hole assembly can be preassembled and the spacings checked out before delivery to the rig site. A standard mud motor can be used without any special bearings. The total hook load is less by the amount of weight of the inner string. There is less of a pressure drop because the mud is not passing through the small inner string. Kick control might be improved in some applications when tripping in the inner string.

[0027] **FIGS. 5A** shows an embodiment of a steerable Drilling Liner system with a steerable drilling liner. Shown is a rig **212** at the surface **208** of the earth. A casing **214** has been set in the upper portion of the borehole. A drilling tubular **216** passes through the casing to a liner hanger **218** at the bottom of the cased portion of the hole and carries a drilling liner - bottom hole assembly (DL-BHA) **222** at its lower end. The DL-BHA has, at its bottom end, a pilot bit **226** and a core bit **224**. A liner **220** hangs from the liner hanger **218** at its top end and is connected to the DL-BHA at its bottom end. These are as discussed above with reference to **FIG. 1.** The lower portion of the system has an MWD assembly **230** with a non-magnetic liner **232.** The MWD assembly **230** offers directional control and can also provide information about the formation being traversed by it. This could include density, resistivity, gamma ray, NMR etc. measurements. The inner DL-BHA assembly **222** includes a flex shaft **234** between the motor and the male sub **254** and core bit **226.** A radial bearing **256** supports the female sub **250** on the male sub **254.** The liner **220** has a bent sub **236** that can be a fixed bend or an Adjustable Kick Off / bend Sub (AKO) making it possible to steer the liner under control of measurements from the MWD assembly **230.** This device may also be used without an inner string between the DL-BHA and the liner hangers, similar to the arrangement discussed above with reference to **FIG. 3.**

[0028] **FIG. 5B** shows a steerable Drilling Liner system that differs from the system shown in **FIG. 5A** in that the motor **322,** MWD device **330** and optional LWD (logging while drilling) are extending out of the core bit **324.** The inner string is centralized inside the liner via stabilizers. There is no non-magnetic liner required. Instead of the flex shaft, male sub and pilot bit a standard stabilized motor **322** (motor stabilization is not shown) with AKO sub **336** and standard drill bit **326** is used on bottom of the inner string. With the MWD / LWD assembly placed in the open hole, full service of geosteering is possible. Geosteering (density, resistivity, gamma ray, NMR etc. measurements) is used to steer along or in between formation boundaries.

[0029] Another arrangement of a steerable Drilling Liner system is shown in **FIG. 6.** Shown is a rig **412** at the surface **410** of the earth. A casing **414** has been set in the upper portion of the borehole. A drilling tubular **416** passes through the casing to a liner hanger **418** at the bottom of the cased portion of the hole and carries a drilling liner bottom hole assembly (DL-BHA) **422** at its lower end. The DL-BHA has, at its bottom end, a pilot bit **426** and a core bit **424.** A liner **420** hangs from the liner hanger **418** its top end is connected to the DL-BHA at its bottom end. These are as discussed above with reference to **FIG. 1.** The lower portion of the system has an MWD assembly **430** with a non-magnetic liner **432.** The MWD assembly **430** offers directional control and can also provide information about the formation being traversed by it. This could include density, resistivity, gamma ray, NMR etc. measurements. The liner **420** can be steered downhole in inclination and azimuth by a steering system featuring retractable and expandable pads **438.** In one embodiment of the invention, the pads **438** are on a non-rotatable sleeve. The liner is rotated within the sleeve whilst the sleeve is non-rotating. The sleeve itself features three or more pads which will be are loaded (expanded) or unloaded (retracted) to push the liner in the desired direction. The use of such a non-rotatable sleeve is would be known to those versed in the art. A commercial embodiment of this is the AUTOTRAK ™ system of Baker Hughes and is not discussed further. An alternative is to use pads within the drilling liner. This device may also be used without an inner string between the DL-BHA and the liner hangers, similar to the arrangement discussed above with reference to **FIG. 3.**

[0030] An alternate embodiment of the device shown in **FIG. 6** uses an expandable stabilizer located at a suitable position **438** on the BHA (the position can vary depending on the application and needs). With such an arrangement, the expandable stabilizer serves as a pivot point enabling steering of the assembly. The use of such an expandable stabilizer would be known to those versed in the art and is not discussed further.

[0031] **FIG. 7** shows an embodiment of the invention using two additional packers. Shown is a rig **512** at the surface **510** of the earth in which a borehole **508** is drilled. A casing **514** has been set in the upper portion of the borehole. A drilling tubular **516** passes through the casing to a liner hanger **518** at the bottom of the cased portion of the hole and carries a drilling liner - bottom hole assembly (DL-BHA) **522** at its lower end. The DL-BHA has, at its bottom end, a pilot bit **526** and a core bit **524** A liner **520** hangs from the liner hanger **518** its top end is connected to the DL-BHA at its bottom end. These are as discussed above with reference to **FIG. 1.** Two additional packers are provided. One is a casing packer **552** just below the liner hanger **518.** The other is an open hole packer **556** located close to the bit.. The mud circulates in the direction indicated by **560,** i.e., down the inner liner, out near the drill bit, back into the outer liner **520** through a port **554,** through the annulus between the inner liner and the outer liner **520.** The advantage of this invention is that there is no mud circulating in the annulus **550** between the outer liner **520** and the borehole **508,** so that the open hole is not affected by the dynamic pressure of the circulated mud system. This reduces the contamination of the formation by the circulating mud.

[0032] This device may also be used with the steering arrangement (**FIG. 5A, 5B** above) and with steerable pads (**FIG. 6** above).

[0033] **FIG. 8** shows an arrangement using an under-reamer on the outside of the outer casing. Shown is a rig **612** at the surface **610** of the earth. A casing **614** has been set in the upper portion of the borehole. A drilling tubular **616** passes through the casing to a liner hanger **618** at the bottom of the cased portion of the hole and carries a drilling liner - bottom hole assembly (DL-BHA) **622** at its lower end. The DL-BHA has, at its bottom end, a pilot bit **626** and a core bit **624.** A liner **620** hangs from the liner hanger **618** at its top end is connected to the DL-BHA at its bottom end. These are as discussed above with reference to **FIG. 1.** The under-reamer **630** is placed in the lower outer part of the liner **620.** With the use of the under-reamer to enlarge the hole drilled by the core bit, it is possible to overcome slip-stick or differential sticking problems or to run an expandable casing. This device may also be used without the inner string (**FIG. 3** above), with the steering arrangement (**FIG. 5A, 5B** above) and with steerable pads (**FIG. 6** above).

[0034] **FIG. 9** illustrates another embodiment of the invention. Shown is a rig **712** at the surface **710** of the earth. A casing **714** has been set in the upper portion of the borehole. A drilling tubular **716** passes through the casing to a liner hanger **718** at the bottom of the cased portion of the hole and carries a drilling liner - bottom hole assembly (DL-BHA) **722** at its lower end. The DL-BHA has, at its bottom end, a pilot bit **726** and a core bit **724.** A liner **720** hangs from the liner hanger **718** at its top end is connected to the DL-BHA at its bottom end. These are as discussed above with reference to **FIG. 1.** The core bit **724** is expandable, as indicated by the arrows **730.** This makes it possible to expand the hole, making it possible to overcome stick-slip or differential sticking problems as well as to run an expandable casing. Alternatively, the pilot bit **726** may be made expandable, in which case, the core bit **724** is not necessary and the male sub with drive splines will not be required. The inner string may then be guided in a radial direction by means of stabilizer pads (not shown). This device may also be used without the inner liner (**FIG. 3** above), with the steering arrangement (**FIG. 5A, 5B** above), with steerable pads (**FIG. 6** above) and with an under reamer (**FIG. 7** above).

[0035] The invention discussed above with respect to **FIGS. 1, 3, 5, 6** and **7** above may also be used with the use of a pilot bit including high pressure jet nozzles (not shown). The high fluid velocity exiting the nozzles washes the formation away to enlarge the hole size. The use of high pressure nozzles to wash out the formation would be known to those versed in the art and is not discussed further. With the use of such a special pilot bit, it is possible to overcome stick-slip or differential sticking problems as well as to run an expandable casing. In addition, with MWD measurements, the well may be deviated in a desired direction by the use of jet nozzles. This requires a system that allows mud flow through the nozzles in only one direction.

[0036] There are instances in the drilling of unusually pressured formations when the upper part of the outer liner gets stuck. In such instances, **FIG. 10** provides a schematic illustration of a DL- BHA **822** where drilling may be continued with the drilling liner. To accomplish this, the inner portion of the DL-BHA has an additional thruster, referred to as the bottom thruster **869.** The main parts of the bottom thruster are the cylinder **870,** the position indicator **871,** the piston **872** and the spline area **873.** The main portions of the drilling motor **859** are indicated as : the landing splines **860,** the bearing section **862** and the drive sub **864.** The suspension sub has an inner and outer portion, labeled as **848b** and **848a** respectively. As in the device disclosed in **FIG. 1,** the male sub **854** is provided with drive splines **850** that engage the female sub. The pilot bit **824** is surrounded by the core bit **826** as in the other embodiments of the invention. The landing sub **844** couples the motor **859** to the suspension sub **848a, 848b.**

[0037] Under normal drilling conditions, the core bit **826** is at the bottom of the hole at the same depth as the pilot bit **824.** The bottom thruster is completely closed and the inner portion of the suspension sub **848b** is fully telescoped inside the outer part **848a.** of the suspension sub. If it some point the outer liner (not shown in **FIG. 9**) gets stuck at some point at or above the motor **859,** the bottom thruster **869** is used to push the pilot bit **824** and the core bit **826** to continue drilling further into the formation until the thruster is fully extended. In such a system, the female and male sub **854** are elongated by the stroke length of the bottom thruster **869** over what would normally be needed.

Claims

1. A drilling liner system for use in continued drilling of a borehole having a casing (14;114;314;414;514; 614;714) therein, the casing (14;114;314;414;514; 614;714) having a drilling tubular (16;116;216;316; 416;516;616;716) inside, the drilling liner system further comprising:

   an inner bottom hole assembly comprising a drilling motor (40;322;859) adapted to be operated by mud conveyed by said tubular (16;116; 216;316;416;516; 616;716) and
   a male sub (54;254;854) rotated by the drilling motor (40;322;859), the male sub (54;254;854) having retractable drive splines (52;850) thereon and coupled to a pilot bit (26;126;226;326; 426;526;626;726;824) for drilling a pilot hole upon operation of the drilling motor (40;322; 859);
   an outer bottom hole assembly comprising a fe-

male sub (50;250) adapted to engage drive splines (52;850) on the male sub (54;254;854) and rotate with the male sub (54;254;854) upon being engaged thereto, and
a core bit (24;124;324;424;524;624;724;826) surrounding the pilot bit (26;126;226;326;426; 526;626;726;824) and coupled to the female sub (50;250) for drilling an enlarged hole,

characterised in that:

a liner hanger/packer assembly (18;118;218; 318;418;518;618;718) is provided at the bottom of the casing; and
a liner (20;120;220;420;520;620;720) is coupled at a first end to the liner hanger/packer assembly (18;118;218;318;418;518;618;718) and at a second end to the outer bottom hole assembly.

2. The drilling liner system according to claim 1, further comprising a releasing tool (128) for releasably coupling the inner bottom hole assembly to the liner (120).

3. The drilling liner system according to claim 2, further comprising a fishable joint (130;160) on the releasing tool (128) for facilitating retrieval of the inner bottom hole assembly from the borehole.

4. The drilling liner system according to claims 1, 2 or 3, further comprising an MWD device (230;330; 430) in the inner bottom hole assembly to provide directional measurements and devices on the inner and outer bottom hole assemblies to facilitate directional drilling.

5. The drilling liner system according to claim 4, wherein the devices on the inner and outer bottom hole assemblies to facilitate directional drilling comprise a plurality of retractable pads (438) on the outside of the outer bottom hole assembly, the retractable pads (438) adapted to engage the borehole wall and to guide the drilling system in a desired direction in inclination and azimuth.

6. The drilling liner system of claim 4 or 5, wherein a section of said liner (220) is a non-magnetic section (232).

7. The drilling liner system of claim 4, 5 or 6, wherein the devices on the inner and outer bottom hole assemblies to facilitate directional drilling comprise a flex shaft (234) between the motor and the male sub (254), and a bent sub (236) on the outer bottom hole assembly above the female sub (250), said bent sub (236) having an adjustable kick off angle or a fixed angle.

8. The drilling liner system according to any preceding claim, further comprising:

a tubular conveying drilling fluid from the drilling tubular to the drilling motor (40;322;859) and pilot bit; and
a casing packer (552) located below the liner hanger/packer assembly (518) and an open hole packer (556) located close to the core bit (526), the casing packer (552) and open hole packer (556) preventing the flow of drilling fluid into an annulus between the liner (520) and the borehole.

9. The drilling liner system according to any preceding claim, wherein at least one of (i) the core bit (24; 124;324;424;524;624;724;826), and (ii) the pilot bit (26;126;226;326;426;526;626;726;824) is expandable.

10. The drilling liner system according to any preceding claim, wherein the pilot bit (26;126;226;326;426; 526;626;726;824) further comprises high pressure jetting nozzles.

11. The drilling liner system according to any preceding claim, further comprising:

a thruster (869) coupled to the male sub (854), the thruster (869) adapted to extend and retract the position of the male sub (54;254;854) relative to the drilling motor (859); and
a telescopic suspension sub coupled to the drilling motor (859) and the female sub (50; 250), the telescopic sub adapted to move the female sub (50;250) in conjunction with the motion of the thruster (869).

12. The drilling liner system according to any preceding claim, further comprising a landing sub (844) with splines (860) thereon for ensuring proper alignment of the inner bottom hole assembly and the outer bottom hole assembly.

13. The drilling liner system according to any preceding claim, further comprising a suspension and bearing sub (848a;848b) for providing longitudinal length suspension and radial guidance and isolating the rotation of the female sub (50;250) from the liner.

14. The drilling liner system according to any preceding claim, wherein the drilling tubular (16;116;216;316; 416;516;616;716) comprising a drill pipe or coiled tubing.

15. The drilling liner system according to any preceding claim, further comprising a reamer (630) on the outside of the outer bottom hole assembly, said reamer

(630) adapted to enlarge the hole drilled by the core bit.

16. A method for continued drilling of a borehole having a casing (14;114;314;414;514;614;714) in a section thereof and a drilling tubular (16;116;216;316;416; 516;616;716) disposed inside the casing, the method comprising:

providing an inner bottom hole assembly comprising a drilling motor (40), and a male sub (54; 254;854) having retractable drive splines (52; 850) and rotated by the drilling motor and coupled to a pilot bit (26;126;226;326;426;526; 626;726;824);
providing an outer bottom hole assembly, the outer bottom hole assembly comprising a female sub (50;250) having a core bit (24;124; 324;424;524;624;724;826) for drilling an enlarged hole, wherein said inner bottom hole assembly is disposed adjacent the outer bottom hole assembly,

the method being **characterised by**:

engaging the female sub (50;250) on the outer bottom hole assembly to the drive splines (52; 850) on the male sub (54;254;854) thereby enabling the core bit (24;124;324;424;524;624; 724;826) to drill an enlarged hole upon operation of the drilling motor (40;322;859);
providing a liner hanger/packer assembly (18; 118;218;318;418;518;618;718) at a bottom of the casing;
coupling a liner (20;120;220;420;520;620;720) at a first end to the liner hanger/packer assembly (18;118;218;318;418;518;618;718) and at a second end to the outer bottom hole assembly;
coupling a second end of the liner (120) to the outer bottom hole assembly;
drilling a pilot hole by operating the drilling motor (40;322;859) by passing mud carried by said tubular.

17. The method according to claim 16, further comprising releasably coupling a releasing tool (128) for the inner bottom hole assembly to the liner (120).

18. The method according to claim 17, further comprising providing a fishable joint (130;160) on the releasing tool (128) for retrieving the inner bottom hole assembly from the borehole.

19. The method according to claim 16, 17 or 18, further comprising:

using an MWD device (230;330;430) to provide directional measurements; and
using devices on the inner and outer bottom hole assemblies to facilitate directional drilling.

20. The method according to claim 19, further comprising:

using a plurality of retractable pads (438) on the outside of the outer bottom hole assembly to engage the borehole wall; and
guiding the inner and outer bottom bole assemblies in a desired direction in inclination and azimuth with the retractable pads.

21. The method of claims 19 or 20, further comprising providing a non-magnetic section (232) on said liner (220).

22. The method of claims 19, 20 or 21, further comprising guiding the inner and outer bottom hole assemblies during directional drilling using a flex shaft (234) between the motor and the male sub (254) and a bent sub (236) on the outer bottom hole assembly above the female sub (250), said bent sub (236) having an adjustable kick off angle or a fixed angle.

23. The method of any of claims 16 to 22, further comprising using a casing packer (552) located below the liner hanger/packer assembly (518) and an open hole packer (556) located close to the core bit (526) for preventing the flow of drilling fluids into an annulus between the liner (520) and the borehole.

24. The drilling method according to any of claims 16 to 23, wherein at least one of (i) the core bit (24;124; 324;424;524;624;724;826), and (ii) the pilot bit (26; 126;226;326;426;526;626;726;824) is expandable.

25. The method according to any of claims 16 to 24, wherein the pilot bit (26;126;226;326;426;526;626; 726;824) comprises high pressure jetting nozzles.

26. The method according to any of claims 16 to 25, further comprising:

coupling a thruster (869) to the male sub, the thruster (869) adapted to extend and retract the position of the male sub (854) relative to the drilling motor (859);
coupling a telescopic suspension sub to the drilling motor (859) and the female sub; and
moving the female sub in conjunction with the motion of the thruster (869) using the telescopic sub.

27. The method according to any of claims 16 to 26, further comprising aligning the inner bottom hole assembly and the outer bottom hole assembly using

a landing sub (844) with splines (860) thereon.

28. The method according to any of claims 18 to 27, further comprising:

providing longitudinal length suspension and radial guidance using a suspension and bearing sub (848a,848b); and
isolating the rotation of the female sub from the liner.

29. The method according to any of claims 16 to 28, wherein the drilling tubular (16;116;216;316;416; 516; 616;716) comprises a drill pipe or coiled tubing.

30. The method of any of claims 16 to 29, further comprising using a reamer (630) on the outside of the outer bottom hole assembly, said reamer (630) adapted to enlarge the hole drilled by the core bit (624).

31. The method of any of claims 16 to 30, further comprising using a thruster (869) on the inner bottom hole assembly to move the male sub (854) relative to the drilling motor (859) and using a telescopic suspension sub on the outer bottom hole assembly to maintain engagement between the female sub and the drive splines (850) on the male sub (854).

Patentansprüche

1. Bohr-Futterrohrsystem, das bei einem ununterbrochenen Bohren eines Bohrlochs verwendet wird, in dem sich ein Gehäuse (14; 114; 314, 414, 514, 614, 714) befindet, wobei sich in dem Gehäuse (14; 114; 314, 414, 514, 614, 714) ein Bohrrohr (16; 116; 216; 316; 416; 516; 616; 716) befindet, wobei das Bohr-Futterrohrsystem des weiteren folgendes umfaßt:

eine innere Bodenlochanordnung, die einen Bohrmotor (40; 322; 859) umfaßt, der dazu ausgelegt ist, mittels durch das Rohr (16; 116; 216; 316; 416; 516; 616; 716) befördertem Schlamm betrieben zu werden, und

eine Steckuntereinheit (54; 254; 854) umfaßt, die durch den Bohrmotor (40; 322; 859) gedreht wird und einfahrbare Antriebskeilnuten (52; 850) aufweist, die mit einer Pilotbohrkrone (26; 126; 226; 326; 426; 526; 626; 726; 824) gekoppelt ist, um bei Betätigung des Bohrmotors (40; 322; 859) ein Pilotloch zu bohren;

eine äußere Bodenlochanordnung, die eine Buchsenuntereinheit (50; 250) umfaßt, die dazu ausgelegt ist, mit Antriebskeilnuten (52; 850) an der Steckunterbaueinheit (54; 254; 854) in Eingriff zu gelangen und sich mit der Steckuntereinheit (54; 254; 854) zu drehen, wenn sie mit ihr in Eingriff ist, und

eine Kernbohrkrone (24; 124; 324; 424; 524; 624; 724; 826) umfaßt, die die Pilotbohrkrone (26; 126; 226; 326; 426; 526; 626; 726; 824) umgibt und mit der Buchsenuntereinheit (50; 250) gekoppelt ist, um ein erweitertes Loch zu bohren,

dadurch gekennzeichnet, daß:

an dem Boden des Gehäuses eine Futterrohraufhängungs/Schieber-Anordnung (18; 118; 218; 318; 418; 518; 618; 718) vorgesehen ist und

ein Futterrohr (20; 120; 220; 420; 520; 620; 720) an einem ersten Ende mit der Futterrohraufhängungs/Schieber-Anordnung (18; 118; 218; 318; 418; 518; 618; 718) und an einem zweiten Ende mit der äußeren Bodenlochanordnung gekoppelt ist.

2. Bohr-Futterrohrsystem nach Anspruch 1, das des weiteren ein Freigabewerkzeug (128) umfaßt, um die innere Bodenlochanordnung lösbar mit dem Futterrohr (120) zu koppeln.

3. Bohr-Futterrohrsystem nach Anspruch 2, das des weiteren an dem Freigabewerkzeug (128) ein herausfischbares Gelenk (130; 160) umfaßt, um die Wiedergewinnung der inneren Bodenlochanordnung aus dem Bohrloch zu erleichtern.

4. Bohr-Futterrohrsystem nach den Ansprüchen 1, 2 oder 3, das des weiteren eine MWD-Vorrichtung (230; 330; 430) in der inneren Bodenlochanordnung zum Ausführen von Richtungsmessungen und Vorrichtungen zum Erleichtern von Richtungsbohren an der inneren und der äußeren Bodenlochanordnung umfaßt.

5. Bohr-Futterrohrsystem nach Anspruch 4, bei dem die Vorrichtungen zum Erleichtern von Richtungsbohren an der inneren und an der äußeren Bodenlochanordnung eine Mehrzahl von einfahrbaren Kissen (438) an der Außenseite der äußeren Bodenlochanordnung umfassen, die dazu ausgelegt sind, mit der Bohrlochwand in Eingriff zu gelangen und das Bohrsystem in einer bezüglich Neigung und Azimut gewünschten Richtung zu führen.

6. Bohr-Futterrohrsystem nach Anspruch 4 oder 5, bei dem ein Querschnitt des Futterrohrs (220) ein nichtmagnetischer Abschnitt (232) ist.

7. Bohr-Futterrohrsystem nach Anspruch 4, 5 oder 6, bei dem die Vorrichtungen zum Erleichtern von Richtungsbohren an der inneren und an der äußeren Bodenlochanordnung eine biegsame Welle (234) zwischen dem Motor und der Steckuntereinheit (254) sowie eine gebogene Untereinheit (236) an der äußeren Bodenlochanordnung über der Buchsenuntereinheit (250) umfassen, wobei die gebogene Untereinheit (236) einen einstellbaren Knickwinkel oder einen festen Winkel besitzt.

8. Bohr-Futterrohrsystem nach einem beliebigen voranstehenden Anspruch, das des weiteren folgendes umfaßt:

ein Rohr, das Bohrfluid von dem Bohrrohr zu dem Bohrmotor (40; 322; 859) und zu der Pilotbohrkrone befördert, und

einen Gehäuseschieber (552), der sich unter der Futterrohraufhängungs-/Schieber-Anordnung (518) befindet, und einen Offenlochschieber (556), der sich in der Nähe der Kernbohrkrone (526) befindet, wobei der Gehäuseschieber (552) und der Offenlochschieber (556) verhindern, daß das Bohrfluid in den Ringraum zwischen dem Futterrohr (520) und dem Bohrloch strömt.

9. Bohr-Futterrohrsystem nach einem beliebigen voranstehenden Anspruch, bei dem (i) die Kernbohrkrone (24; 124; 324; 424; 524; 624; 724; 826) und/oder (ii) die Pilotbohrkrone (26; 126; 226; 326; 426; 526; 626; 726; 824) ausdehnbar sind.

10. Bohr-Futterrohrsystem nach einem beliebigen voranstehenden Anspruch, bei dem die Pilotbohrkrone (26; 126; 226; 326; 426; 526; 626; 726; 824) des weiteren Hochdruckstrahldüsen umfaßt.

11. Bohr-Futterrohrsystem nach einem beliebigen voranstehenden Anspruch, das des weitern folgendes umfaßt:

eine Schubvorrichtung (869), die mit der Steckuntereinheit (854) gekoppelt ist und dazu ausgelegt ist, die Position der Steckuntereinheit (54; 254; 854) in Bezug auf den Bohrmotor (859) auszufahren und einzufahren, und

eine Teleskopaufhängungs-Untereinheit, die mit dem Bohrmotor (859) und mit der Buchsenuntereinheit (50; 250) gekoppelt ist und die dazu ausgelegt ist, die Buchsenuntereinheit (50; 250) in Verbindung mit der Bewegung der Schubvorrichtung (869) zu bewegen.

12. Bohr-Futterrohrsystem nach einem beliebigen voranstehenden Anspruch, das des weiteren eine Auflegeuntereinheit (844) mit daran befindlichen Keilnuten (860) zum Sicherstellen der korrekten Ausrichtung der inneren Bodenlochanordnung und der äußeren Bodenlochanordnung umfaßt.

13. Bohr-Futterrohrsystem nach einem beliebigen voranstehenden Anspruch, das des weiteren eine Aufhängungs- und Lagerungs-Untereinheit (848a, 848b) umfaßt, die eine Aufhängung in longitudinaler Richtung sowie eine radiale Führung und eine Isolation der Drehung der Buchsenuntereinheit (50; 250) von dem Futterrohr schafft.

14. Bohr-Futterrohrsystem nach einem beliebigen voranstehenden Anspruch, bei dem das Bohrrohr (16; 116; 216; 316; 416; 516; 616; 716) eine Bohrröhre oder ein schraubenlinienförmiges Rohr umfaßt.

15. Bohr-Futterrohrsystem nach einem beliebigen voranstehenden Anspruch, das des weitern an der Außenseite der äußeren Bodenlochanordnung einen Erweiterungsbohrer (630) umfaßt, der dazu ausgelegt ist, das von der Kernbohrkrone gebohrte Loch zu erweitern.

16. Verfahren zum ununterbrochenen Bohren eines Bohrlochs, das in einem Abschnitt ein Gehäuse (14; 114; 314, 414, 514, 614, 714) sowie ein in dem Gehäuse angeordnetes Bohrrohr (16; 116; 216; 316; 416; 516; 616; 716) aufweist, wobei das Verfahren folgende Schritte umfaßt:

Vorsehen einer inneren Bodenlochanordnung, die einen Bohrmotor (40) und eine Steckuntereinheit (54; 254; 854) mit einfahrbaren Antriebskeilnuten (52; 850) aufweist, wobei die Steckuntereinheit durch den Bohrmotor gedreht wird und mit einer Pilotbohrkrone (26; 126; 226; 326; 426; 526; 626; 726; 824) gekoppelt ist,

Vorsehen einer äußeren Bodenlochanordnung, die eine Buchsenuntereinheit (50; 250) mit einer Kernbohrkrone (24; 124; 324; 424; 524; 624; 724;. 826) zum Bohren eines erweiterten Lochs umfaßt, wobei die innere Bodenlochanordnung in der Nähe der äußeren Bodenlochanordnung angeordnet ist,

wobei das Verfahren **gekennzeichnet ist durch** die Schritte:

Herstellen eines Eingriffs zwischen der Buchsenuntereinheit (50; 250) an der äußeren Bodenlochanordnung mit den Antriebskeilnuten (52; 850) an der Steckuntereinheit (54; 254; 854), damit die Kernbohrkrone (24; 124; 324;

424; 524; 624; 724; 826) bei Betätigung des Bohrmotors (40; 322; 859) ein erweitertes Loch bohren kann,

Vorsehen einer Futterrohraufhängungs-/Schieber-Anordnung (18; 118; 218; 318; 418; 518; 618; 718) an dem Boden des Gehäuses,

Koppeln eines Futterrohrs (20;120;220;420; 520;620;720) an einem ersten Ende mit der Futterrohraufhängungs-/Schieber-Anordnung (18; 118; 218; 318; 418; 518; 618; 718) und an einem zweiten Ende mit der äußeren Bodenlochanordnung,

Koppeln eines zweiten Endes des Futterrohrs (120) mit der äußeren Bodenlochanordnung,

Bohren eines Pilotlochs **durch** Betätigen des Bohrmotors (40; 322; 859) **durch** Hindurchschicken von Schlamm, der von dem Rohr befördert wird.

17. Verfahren nach Anspruch 16, das des weiteren das lösbare Koppeln eines Freigabewerkzeugs (128) für die innere Bodenlochanordnung mit dem Futterrohr (120) umfaßt.

18. Verfahren nach Anspruch 17, das des weiteren das Vorsehen eines herausfischbaren Gelenks (130; 160) an dem Freigabewerkzeug (128) umfaßt, um die innere Bodenlochanordnung aus dem Bohrloch wiederzugewinnen.

19. Verfahren nach Anspruch 16, 17 oder 18, das des weiteren folgendes umfaßt:

Verwenden einer MWD-Vorrichtung (230; 330; 430) zum Bereitstellen von Richtungsmessungen und

Verwenden von Vorrichtungen an der inneren und an der äußeren Bodenlochanordnung zum Erleichtern von Richtungsbohren.

20. Verfahren nach Anspruch 19, das des weiteren folgendes umfaßt:

Verwenden einer Mehrzahl von einfahrbaren Kissen (438) an der Außenseite der äußeren Bodenlochanordnung, die mit der Bohrlochwand in Eingriff gelangen, und

Führen der inneren und der äußeren Bodenlochanordnung in einer in Bezug auf die Neigung und den Azimut gewünschten Richtung mittels der einfahrbaren Kissen.

21. Verfahren nach den Ansprüchen 19 oder 20, das des weiteren das Vorsehen eines--nichtmagnetischen Abschnitts (232) an dem Futterrohr (220) umfaßt.

22. Verfahren nach den Ansprüchen 19, 20 oder 21, das des weiteren das Führen der inneren und der äußeren Bodenlochanordnung während des Richtungsbohrens unter Verwendung einer biegsamen Welle (234) zwischen dem Motor und der Steckuntereinheit (254) und unter Verwendung einer gebogenen Untereinheit (236) an der äußeren Bodenlochanordnung über der Buchsenuntereinheit (250) umfaßt, wobei die gebogene Untereinheit (236) einen einstellbaren Knickwinkel oder einen festen Winkel aufweist.

23. Verfahren nach einem der Ansprüche 16 bis 22, das des weiteren das Verwenden eines Gehäuseschiebers (552), der sich unterhalb der Futterrohraufhängungs-/Schieber-Anordnung (518) befindet, und eines Offenlochschiebers (556), der sich in der Nähe der Kernbohrkrone (526) befindet, umfaßt, um eine Strömung von Bohrfluiden in einen Ringraum zwischen dem Futterrohr (520) und dem Bohrloch zu verhindern.

24. Bohrverfahren nach einem der Ansprüche 16 bis 23, bei dem (i) die Kernbohrkrone (24; 124; 324; 424; 524; 624; 724; 826) und/oder (ii) die Pilotbohrkrone (26; 126; 226; 326; 426; 526; 626; 726; 824) ausdehnbar sind.

25. Verfahren nach einem der Ansprüche 16 bis 24, bei dem die Pilotbohrkrone (26; 126; 226; 326; 426; 526; 626; 726; 824) Hochdruckstrahldüsen umfaßt.

26. Verfahren nach einem der Ansprüche 16 bis 25, das des weiteren folgendes umfaßt:

Koppeln einer Schubvorrichtung (869) mit der Steckuntereinheit, wobei die Schubvorrichtung (869) dazu ausgelegt ist, die Position der Steckuntereinheit (854) in Bezug auf den Bohrmotor (859) auszufahren und einzufahren,

Koppeln einer Teleskopaufhängungs-Untereinheit mit dem Bohrmotor (859) und mit der Buchsenuntereinheit und

Bewegen der Buchsenuntereinheit zusammen mit der Bewegung der Schubvorrichtung (869) unter Verwendung der Teleskop-Untereinheit.

27. Verfahren nach einem der Ansprüche 16 bis 26, das des weiteren das Ausrichten der inneren Bodenlochanordnung und der äußeren Bodenlochbaueinheit unter Verwendung einer Aufliegeuntereinheit

(854) mit daran befindlichen Keilnuten umfaßt.

28. Verfahren nach einem der Ansprüche 18 bis 27, das des weiteren folgendes umfaßt:

Vorsehen einer longitudinalen Längsaufhängung und einer radialen Führung unter Verwendung einer Aufhängungs- und

Lagerungs-Untereinheit (848a, 848b) und

Isolieren der Drehung der Buchsenuntereinheit gegenüber dem Futterrohr.

29. Verfahren nach einem der Ansprüche 16 bis 28, bei dem das Bohrrohr (16; 116; 216; 316; 416; 516; 616; 716) eine Bohrröhre oder ein schraubenlinienförmiges Rohr umfaßt.

30. Verfahren nach einem der Ansprüche 16 bis 29, das des weiteren das Verwenden eines Erweiterungsbohrers (630) an der Außenseite der äußeren Bodenlochanordnung umfaßt, wobei der Erweiterungsbohrer (630) dazu ausgelegt ist, das von der Kernbohrkrone (624) gebohrte Loch zu erweitern.

31. Verfahren nach einem der Ansprüche 16 bis 30, das des weiteren das Verwenden einer Schubvorrichtung (869) an der inneren Bodenlochanordnung, um die Steckuntereinheit (854) relativ zu dem Bohrmotor (859) zu bewegen, und das Verwenden einer Teleskopaufhängungs-Untereinheit an der äußeren Bodenlochanordnung, um den Eingriff zwischen der Buchsenuntereinheit und den Antriebskeilnuten (850) an der Steckuntereinheit (854) aufrechtzuerhalten, umfaßt.

Revendications

1. Système de chemise de forage à utiliser lors du forage continu d'un trou de forage, comprenant un cuvelage (14; 114; 314; 414; 514; 614; 714) dans celui-ci, le cuvelage (14; 114; 314; 414; 514; 614; 714) contenant un tube de forage (16; 116; 216; 316; 416; 516; 616; 716) à l'intérieur, le système de chemise de forage comprenant en outre:

un ensemble de trou de fond intérieur comprenant un moteur de forage (40; 322; 859) apte à être actionné par la boue charriée par ledit tube (16; 116; 216; 316; 416; 516; 616; 716), et
un manchon mâle (54; 254; 854) mis en rotation par le moteur de forage (40; 322; 859), le manchon mâle (54; 254; 854) comportant sur lui des cannelures d'entraînement rétractables (52; 850) et étant couplé à un foret pilote (26; 126; 226; 326; 426; 526; 626; 726; 824) pour forer un trou pilote pendant le fonctionnement du moteur de forage (40; 322; 859);
un ensemble de trou de fond extérieur comprenant un manchon femelle (50; 250) apte à engager les cannelures d'entraînement (52; 850) sur le manchon mâle (54; 254; 854) et à tourner avec le manchon mâle (54; 254; 854) lorsqu'il est engagé sur celui-ci; et
une couronne de carottier (24; 124; 324; 424; 524; 624; 724; 826) qui entoure le foret pilote (26; 126; 226; 326; 426; 526; 626; 726; 824) et qui est couplée au manchon femelle (50; 250) pour forer un trou agrandi,

caractérisé en ce que:

un ensemble de suspension/bourrage de chemise (18; 118; 218; 318; 418; 518; 618; 718) est prévu au fond du cuvelage; et
une chemise (20; 120; 220; 420; 520; 620; 720) est couplée par une première extrémité à l'ensemble de suspension/bourrage de chemise (18; 118; 218; 318; 418; 518; 618; 718) et par une deuxième extrémité à l'ensemble de trou de fond extérieur.

2. Système de chemise de forage suivant la revendication 1, comprenant en outre un outil détachable (128) qui permet de coupler d'une façon détachable l'ensemble de trou de fond intérieur à la chemise (120).

3. Système de chemise de forage suivant la revendication 2, comprenant en outre un joint de repêchage (130; 160) sur l'outil détachable (128) destiné à faciliter le retrait de l'ensemble de trou de fond intérieur hors du trou de forage.

4. Système de chemise de forage suivant la revendication 1, 2 ou 3, comprenant en outre un dispositif MWD (230; 330; 430) dans l'ensemble de trou de fond intérieur destiné à procurer des mesures directionnelles et des dispositifs sur les ensembles de trou de fond intérieur et extérieur ayant pour but de faciliter le forage directionnel.

5. Système de chemise de forage suivant la revendication 4, dans lequel les dispositifs sur les ensembles de trou de fond intérieur et extérieur destinés à faciliter le forage directionnel comprennent une pluralité de coussins rétractables (438) sur l'extérieur de l'ensemble de trou de fond extérieur, les coussins rétractables (438) étant aptes à engager la paroi du trou de forage et à guider le système de forage dans une direction souhaitée en inclinaison et en azimut.

6. Système de chemise de forage suivant la revendi-

cation 4 ou 5, dans lequel une section de ladite chemise (220) est une section non magnétique (232).

7. Système de chemise de forage suivant la revendication 4, 5 ou 6, dans lequel les dispositifs sur les ensembles de trou de fond intérieur et extérieur destinés à faciliter le forage directionnel comprennent un arbre flexible (234) entre le moteur et le manchon mâle (254), et un manchon coudé (236) sur l'ensemble de trou de fond extérieur au-dessus du manchon femelle (250), ledit manchon coudé (236) présentant un angle de démarrage réglable ou un angle fixe.

8. Système de chemise de forage suivant l'une quelconque des revendications précédentes, comprenant en outre:

un tube transportant un fluide de forage à partir du tube de forage jusqu'au moteur de forage (40; 322; 859) et jusqu'au foret pilote; et
un bourrage de cuvelage (552) situé en dessous de l'ensemble de suspension/bourrage de chemise (518) et un bourrage de trou ouvert (556) situé à proximité de la couronne de carottier (526), le bourrage de cuvelage (552) et le bourrage de trou ouvert (556) empêchant un écoulement de fluide de forage dans un espace annulaire entre la chemise (520) et le trou de forage.

9. Système de chemise de forage suivant l'une quelconque des revendications précédentes, dans lequel au moins un élément parmi (i) la couronne de carottier (24; 124; 324; 424; 524; 624; 724; 826), et (ii) le foret pilote (26; 126; 226; 326; 426; 526; 626; 726; 824) peut être expansé.

10. Système de chemise de forage suivant l'une quelconque des revendications précédentes, dans lequel le foret pilote (26; 126; 226; 326; 426; 526; 626; 726; 824) comprend en outre des tuyères de projection à haute pression.

11. Système de chemise de forage suivant l'une quelconque des revendications précédentes, comprenant en outre:

un vérin (869) couplé au manchon mâle (854), le vérin (869) étant apte à étendre et à rétracter la position du manchon mâle (54; 254; 854) par rapport au moteur de forage (859); et
un manchon de suspension télescopique couplé au moteur de forage (859) et au manchon femelle (50; 250), le manchon télescopique étant apte à déplacer le manchon femelle (50; 250) en conjonction avec le déplacement du vérin (869).

12. Système de chemise de forage suivant l'une quelconque des revendications précédentes, comprenant en outre un manchon d'appui (844) comportant sur lui des cannelures (860) destinées à assurer l'alignement correct de l'ensemble de trou de fond intérieur avec l'ensemble de trou de fond extérieur.

13. Système de chemise de forage suivant l'une quelconque des revendications précédentes, comprenant en outre un manchon de suspension et de support (848a, 848b) servant à procurer une suspension de longueur longitudinale et un guidage radial et à isoler la rotation du manchon femelle (50; 250) par rapport à la chemise.

14. Système de chemise de forage suivant l'une quelconque des revendications précédentes, dans lequel le tube de forage (16; 116; 216; 316; 416; 516; 616; 716) comprend un tige de sondage ou un serpentin.

15. Système de chemise de forage suivant l'une quelconque des revendications précédentes, comprenant en outre un alésoir (630) sur l'extérieur de l'ensemble de trou de fond extérieur, ledit alésoir (630) étant apte à agrandir le trou foré par la couronne de carottier.

16. Procédé pour forer en continu un trou de forage comportant un cuvelage (14; 114; 314; 414; 514; 614; 714) dans une section de celui-ci, et un tube de forage (16; 116; 216; 316; 416; 516; 616; 716) disposé à l'intérieur du cuvelage, le procédé comprenant les étapes consistant à;

fournir un ensemble de trou de fond intérieur comprenant un moteur de forage (40) et un manchon mâle (54; 254; 854) comportant des cannelures d'entraînement rétractables (52; 850) et mis en rotation par le moteur de forage et couplé à un foret pilote (26; 126; 226; 326; 426; 526; 626; 726; 824);

fournir un ensemble de trou de fond extérieur, l'ensemble de trou de fond extérieur comprenant un manchon femelle (50; 250) comportant une couronne de carottier (24; 124; 324; 424; 524; 624; 724; 826) pour forer un trou agrandi, dans lequel ledit ensemble de trou de fond intérieur est disposé à proximité de l'ensemble de trou de fond extérieur,

le procédé étant **caractérisé par**:

l'engagement du manchon femelle (50; 250) sur l'ensemble de trou de fond extérieur sur les cannelures d'entraînement (52; 850) présentes sur le manchon mâle (54; 254; 854) permettant de ce fait à la couronne de carottier (24; 124; 324; 424; 524; 624; 724; 826) de forer un trou agrandi lors du fonctionnement du moteur de forage (40; 322; 859);
la fourniture d'un ensemble de suspension/

bourrage de chemise (18; 118; 218; 318; 418; 518; 618; 718) au fond du cuvelage;
le couplage d'une chemise (20; 120; 220; 420; 520; 620; 720) par une première extrémité à l'ensemble de suspension/bourrage de chemise (18; 118; 218; 318; 418; 518; 618; 718) et par une deuxième extrémité à l'ensemble de trou de fond extérieur;
le couplage d'une deuxième extrémité de la chemise (120) à l'ensemble de trou de fond extérieur; et
le forage d'un trou pilote en actionnant le moteur de forage (40; 322; 859) en faisant passer la boue charriée par ledit tube.

17. Procédé suivant la revendication 16, comprenant en outre le couplage détachable d'un outil détachable (128) de l'ensemble de trou de fond intérieur à la chemise (120).

18. Procédé suivant la revendication 17, comprenant en outre la fourniture d'un joint de repêchage (130; 160) sur l'outil de fixation (128) destiné à faciliter le retrait de l'ensemble de trou de fond intérieur hors du trou de forage.

19. Procédé suivant la revendication 16, 17 ou 18, comprenant en outre:

l'utilisation d'un dispositif MWD (230; 330; 430) destiné à procurer des mesures directionnelles; et
l'utilisation de dispositifs sur les ensembles de trou de fond intérieur et extérieur dans le but de faciliter le forage directionnel.

20. Procédé suivant la revendication 19, comprenant en outre:

l'utilisation d'une pluralité de coussins rétractables (438) sur l'extérieur de l'ensemble de trou de fond extérieur afin d'engager la paroi du trou de forage; et
le guidage des ensembles de trou de fond intérieur et extérieur dans une direction souhaitée en inclinaison et en azimut avec les coussins rétractables.

21. Procédé suivant la revendication 19 ou 20, comprenant en outre la fourniture d'une section non magnétique (232) sur ladite chemise (220).

22. Procédé suivant la revendication 19, 20 ou 21, comprenant en outre le guidage des ensembles de trou de fond intérieur et extérieur durant le forage directionnel en utilisant un arbre flexible (234) entre le moteur et le manchon mâle (254), et un manchon coudé (236) sur l'ensemble de trou de fond extérieur au-dessus du manchon femelle (250), ledit manchon coudé (236) présentant un angle de démarrage réglable ou un angle fixe.

23. Procédé suivant l'une quelconque des revendications 16 à 22, comprenant en outre l'utilisation d'un bourrage de cuvelage (552) situé en dessous de l'ensemble de suspension/bourrage de chemise (518) et d'un bourrage de trou ouvert (556) situé à proximité de la couronne de carottier (526) et destiné à empêcher l'écoulement des fluides de forage dans un espace annulaire entre la chemise (520) et le trou de forage.

24. Procédé de forage suivant l'une quelconque des revendications 16 à 23, dans lequel au moins un élément parmi (i) la couronne de carottier (24; 124; 324; 424; 524; 624; 724; 826), et (ii) le foret pilote (26; 126; 226; 326; 426; 526; 626; 726; 824) peut être expansé.

25. Procédé suivant l'une quelconque des revendications 16 à 24, dans lequel le foret pilote (26; 126; 226; 326; 426; 526; 626; 726; 824) comprend en outre des tuyères de projection à haute pression.

26. Procédé suivant l'une quelconque des revendications 16 à 25, comprenant en outre:

le couplage d'un vérin (869) au manchon mâle (854), le vérin (869) étant apte à étendre et à rétracter la position du manchon mâle (854) par rapport au moteur de forage (859);
le couplage d'un manchon de suspension télescopique au moteur de forage (859) et au manchon femelle; et
le déplacement du manchon femelle en conjonction avec le déplacement du vérin (869) en utilisant le manchon télescopique.

27. Procédé suivant l'une quelconque des revendications 16 à 26, comprenant en outre l'alignement de l'ensemble de trou de fond intérieur et de l'ensemble de trou de fond extérieur en utilisant un manchon d'appui (844) comportant sur lui des cannelures (860).

28. Procédé suivant l'une quelconque des revendications 18 à 27, comprenant en outre:

la fourniture d'une suspension de longueur longitudinale et d'un guidage radial en utilisant un manchon de suspension et de support (848a, 848b); et
l'isolation de la rotation du manchon femelle par rapport à la chemise.

29. Procédé suivant l'une quelconque des revendica-

tions 16 à 28, dans lequel le tube de forage (16; 116; 216; 316; 416; 516; 616; 716) comprend une tige de sondage ou un serpentin.

30. Procédé suivant l'une quelconque des revendications 16 à 29, comprenant en outre un alésoir (630) sur l'extérieur de l'ensemble de trou de fond extérieur, ledit alésoir (630) étant apte à agrandir le trou foré par la couronne de carottier (624).

31. Procédé suivant l'une quelconque des revendications 16 à 30, comprenant en outre l'utilisation d'un vérin (869) sur l'ensemble de trou de fond intérieur afin de déplacer le manchon mâle (854) par rapport au moteur de forage (859), et l'utilisation d'un manchon de suspension télescopique sur l'ensemble de trou de fond extérieur afin de maintenir un engagement entre le manchon femelle et les cannelures d'entraînement (850) présentes sur le manchon mâle (854).

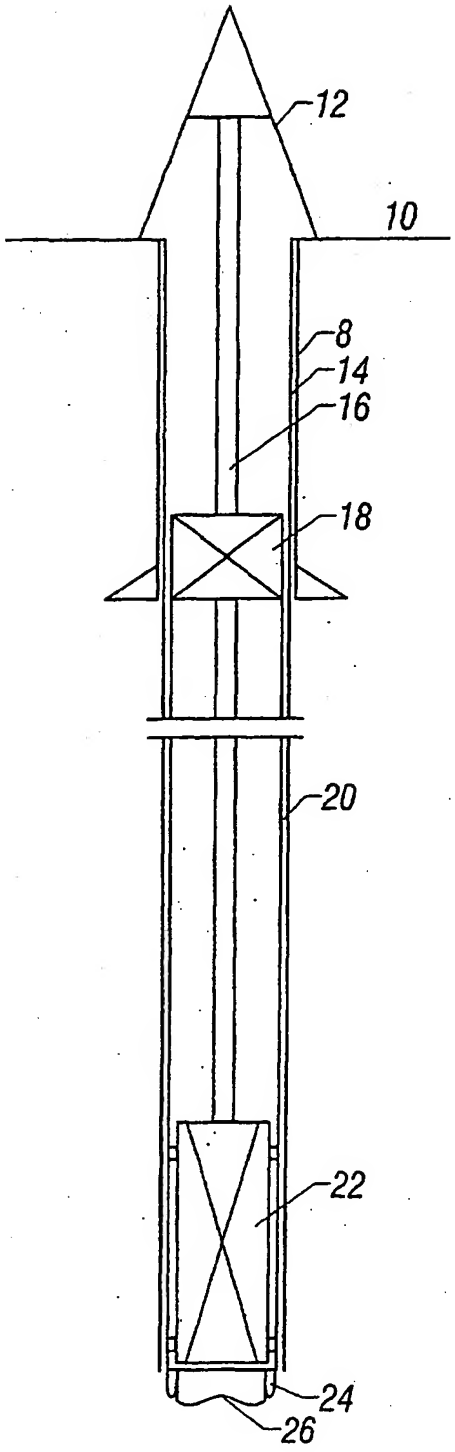

FIG. 1

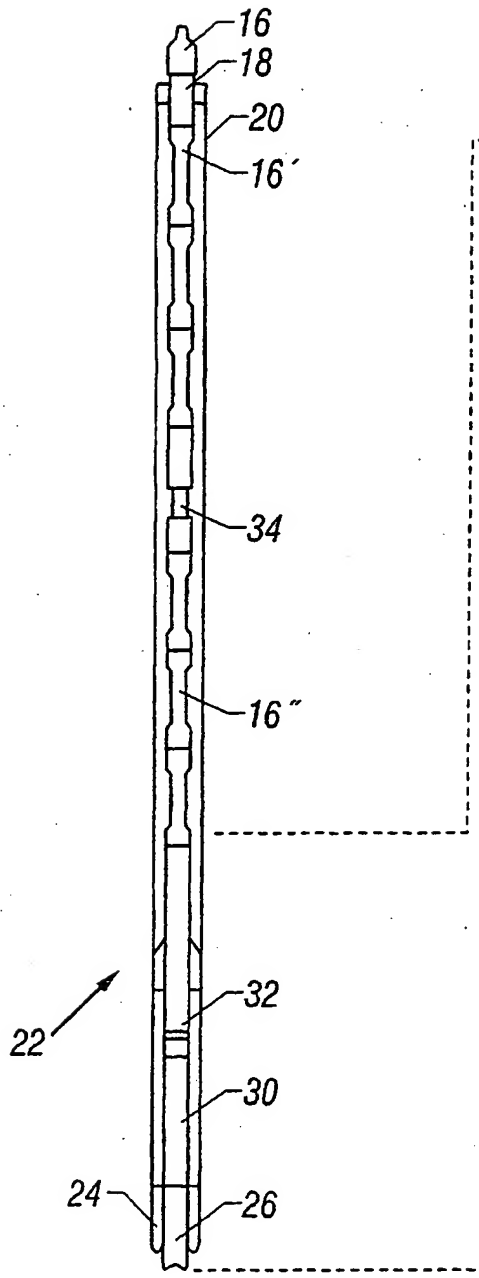

FIG. 2A

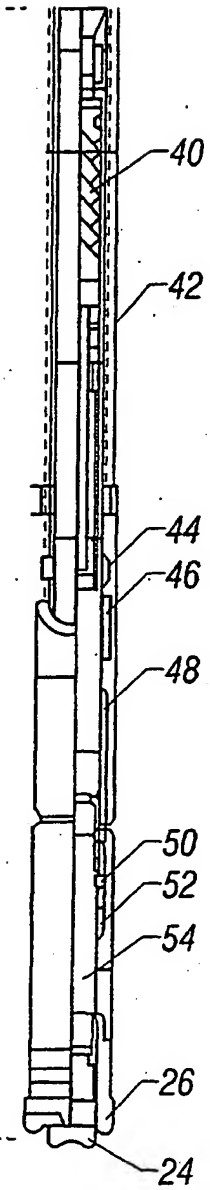

FIG. 2B

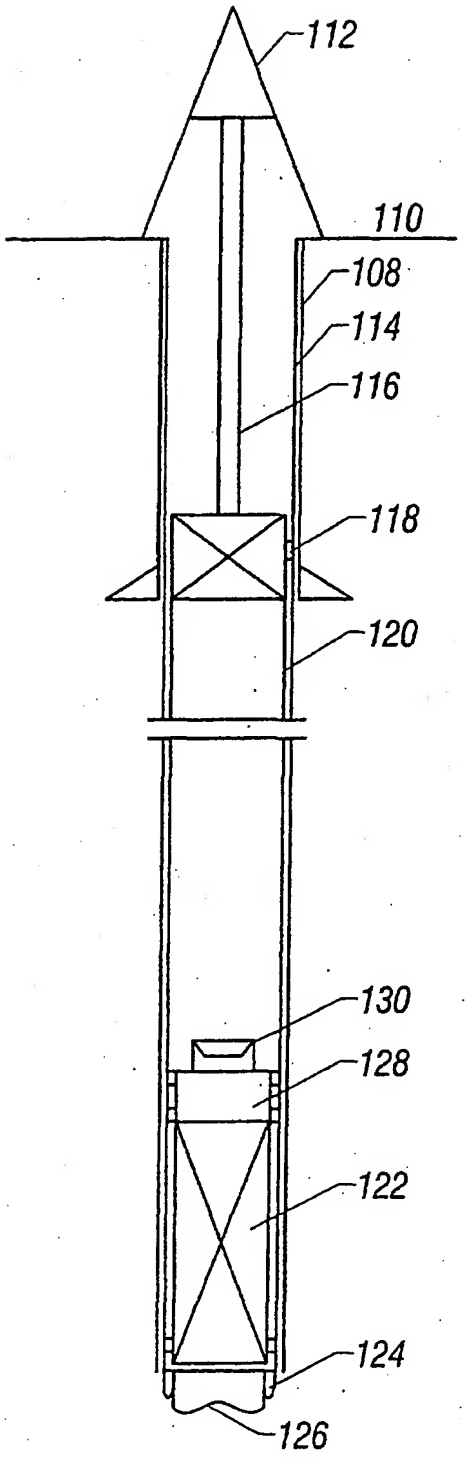

FIG. 3

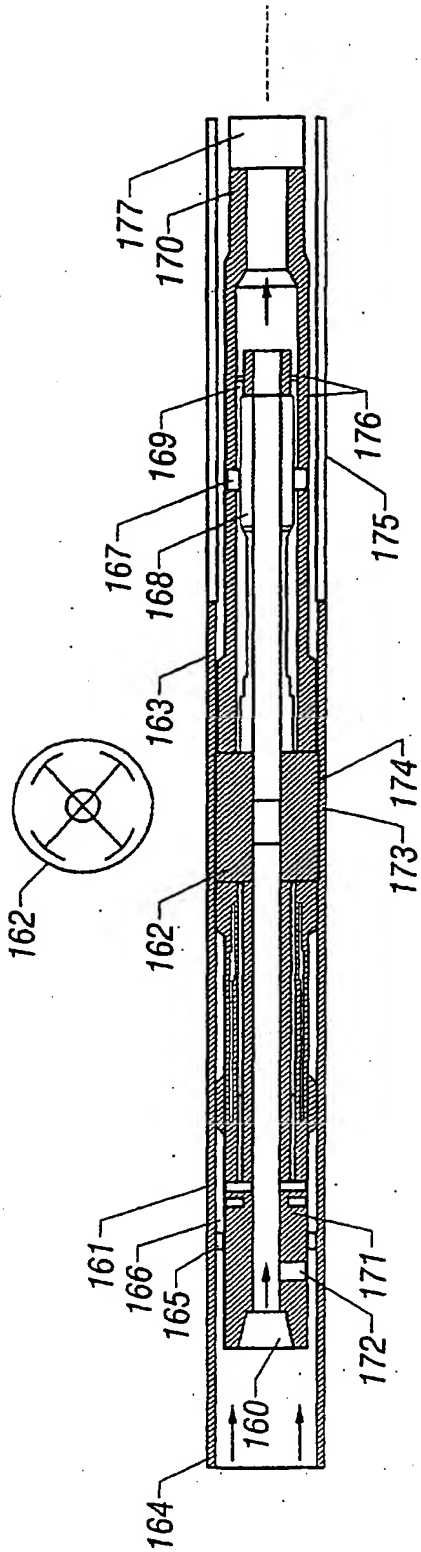
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FIG. 4a

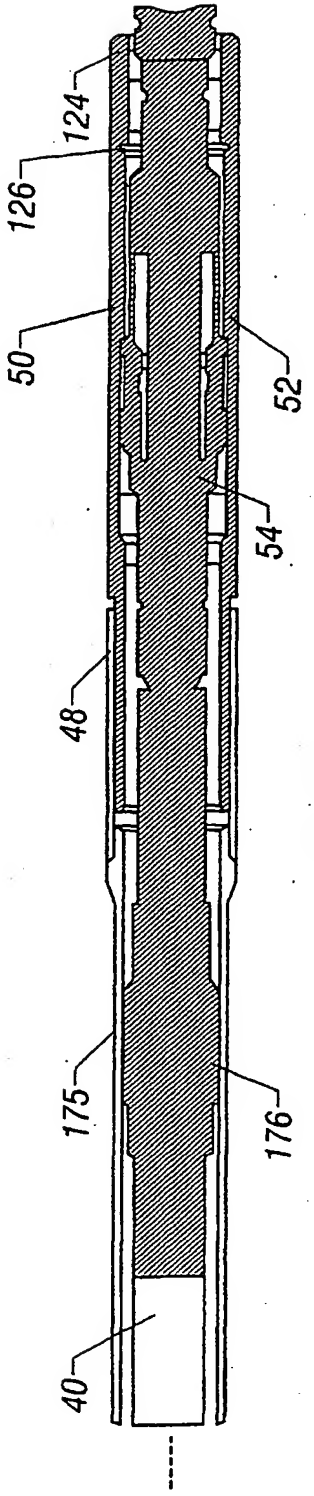
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FIG. 4b

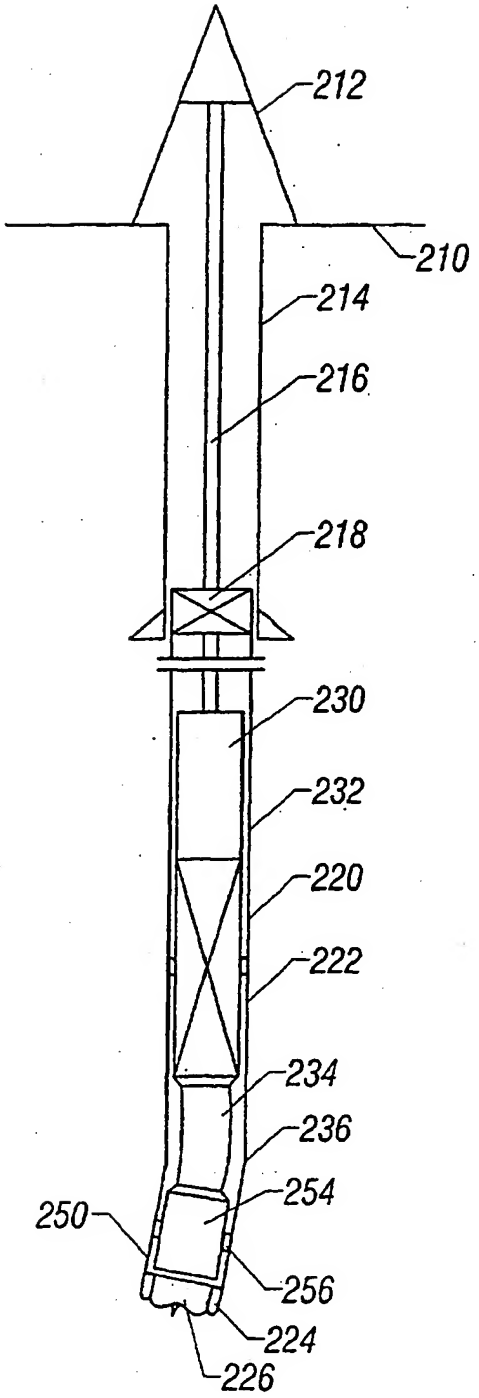
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FIG. 5A

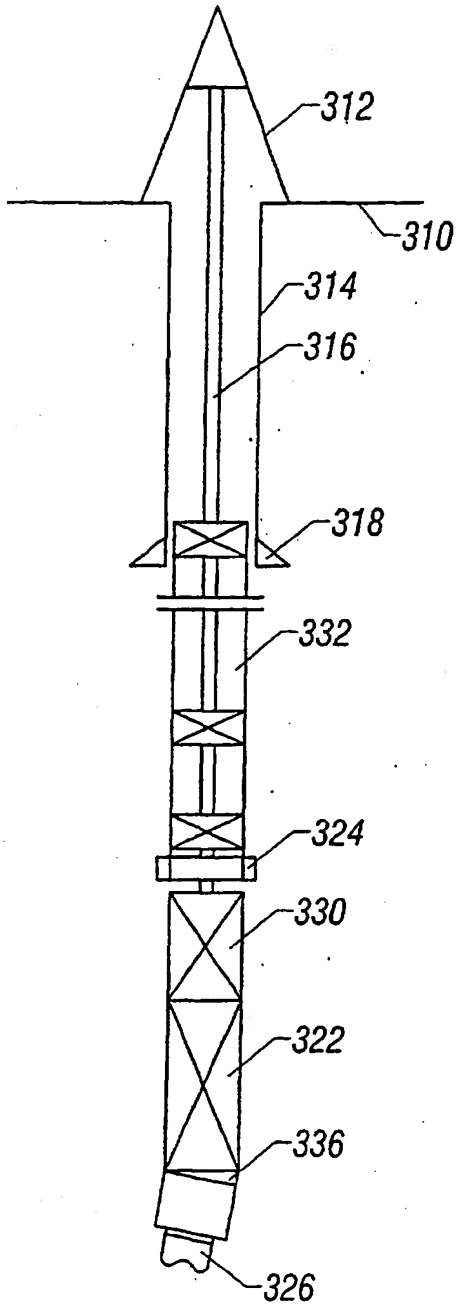
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FIG. 5B

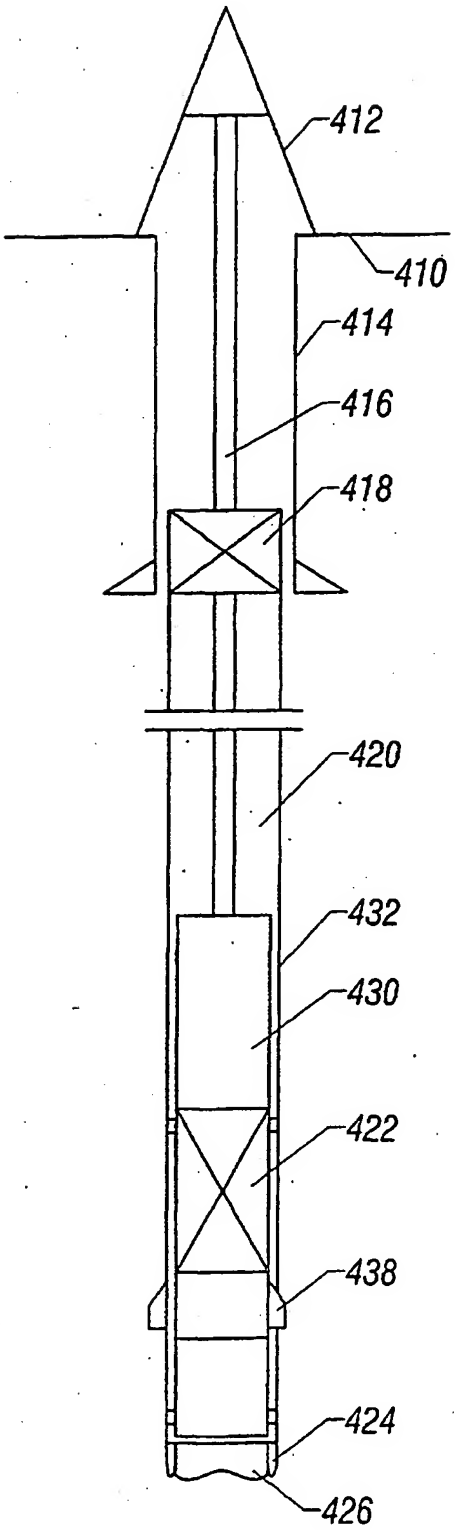

FIG. 6

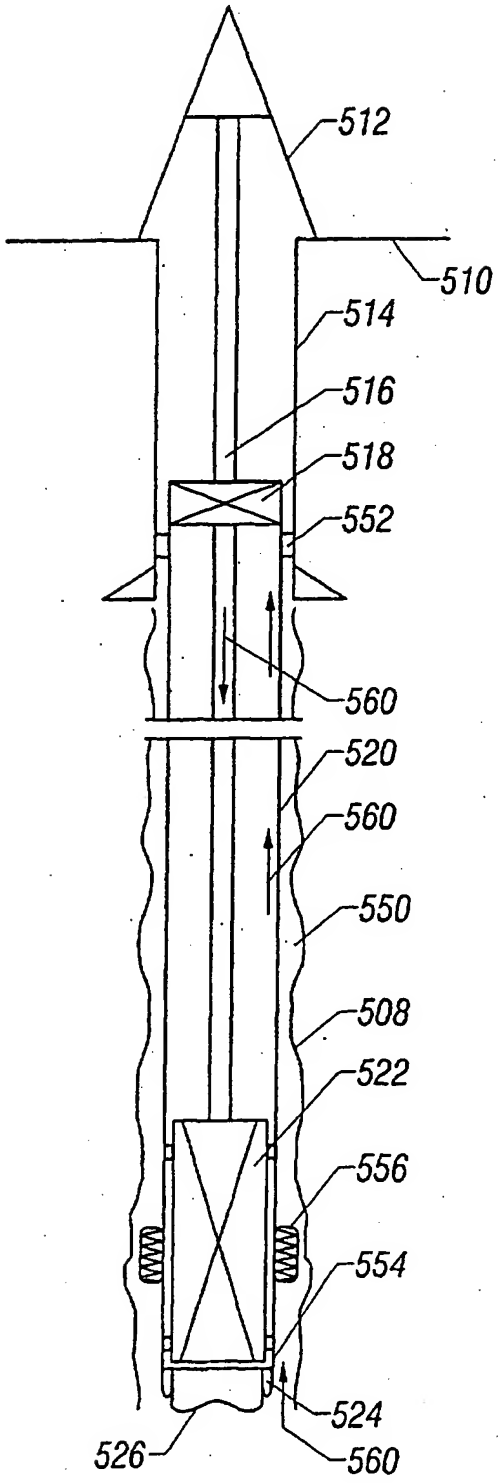
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FIG. 7

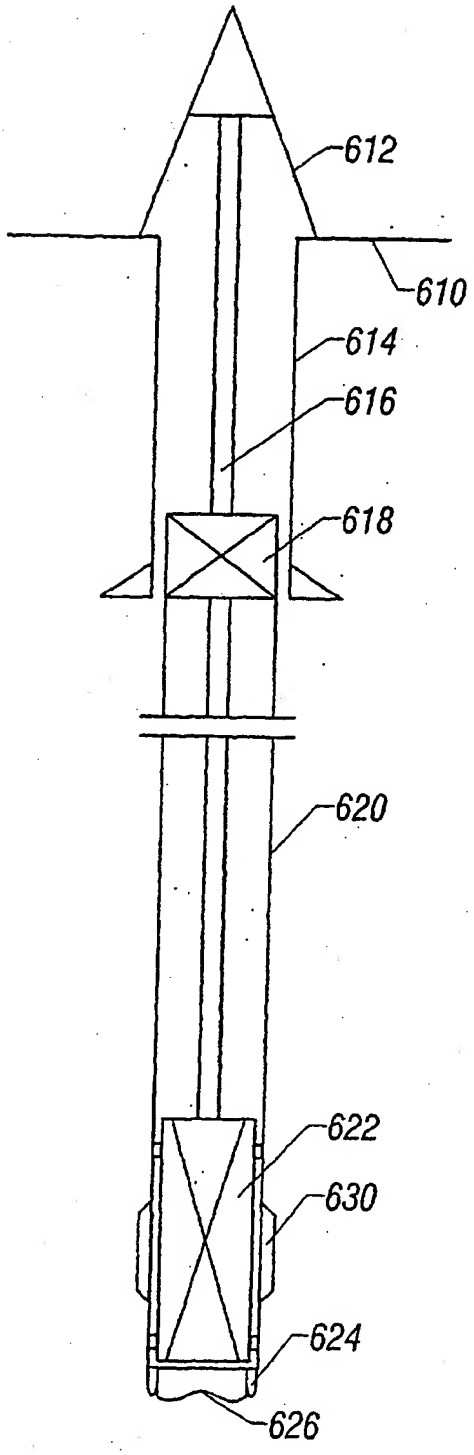

FIG. 8

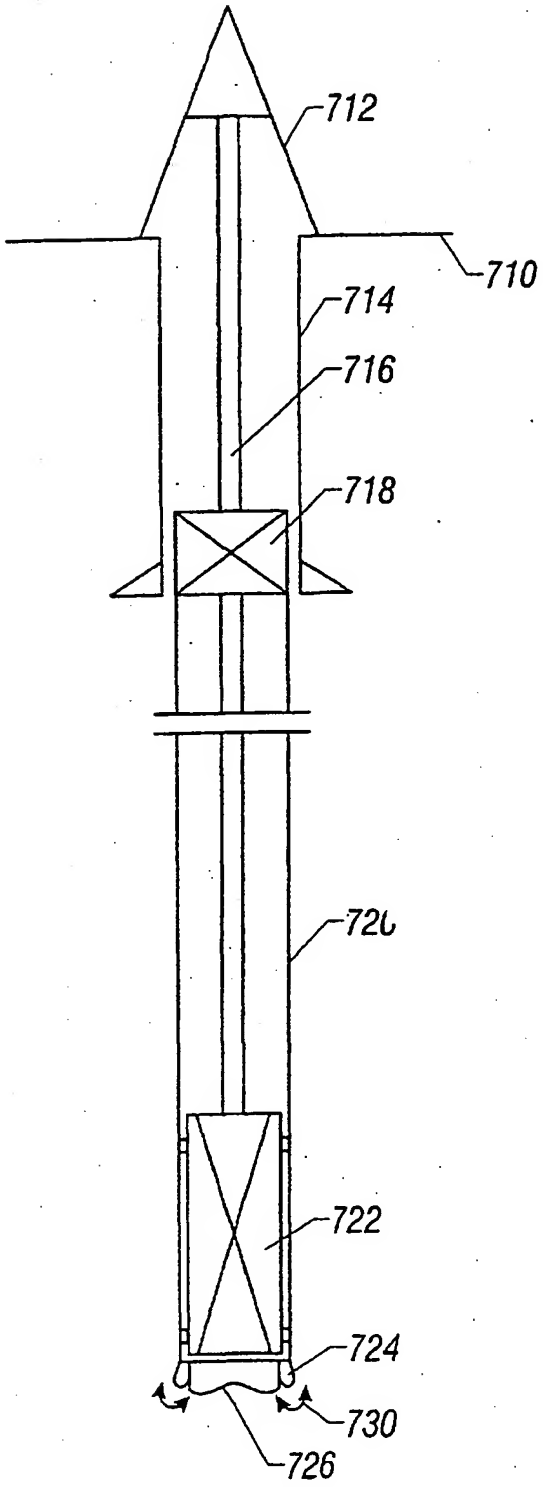

FIG. 9

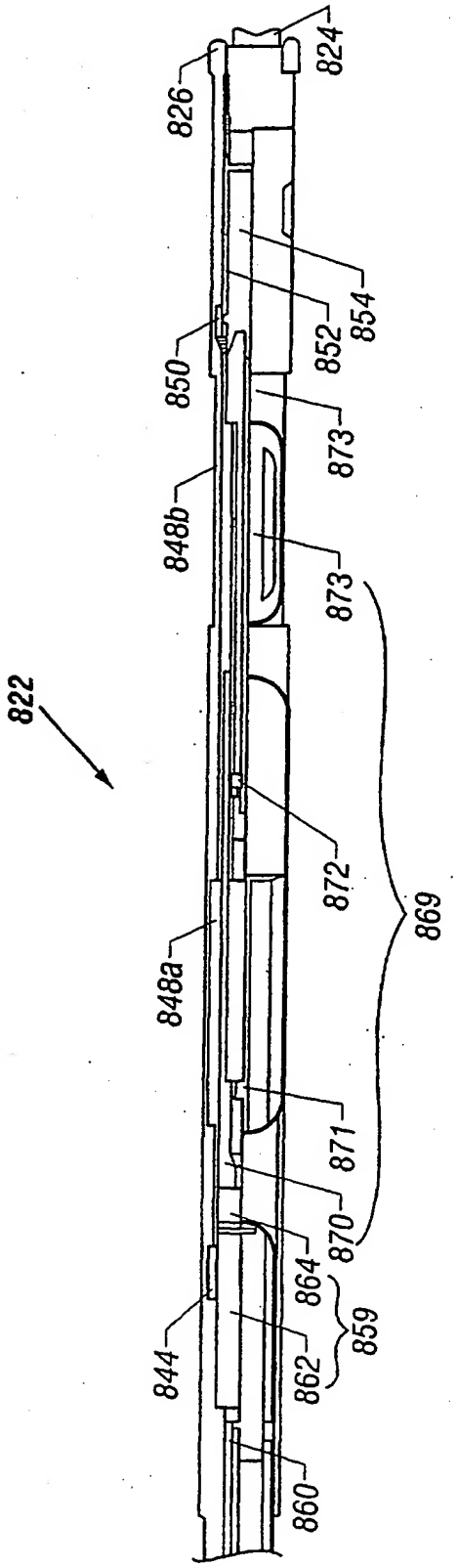
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FIG. 10